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ENTREPRENEURSHIP, SUSTAINABILITY, AND SOLAR DISTRIBUTED GENERATION

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Abstract. The issues associated with the generation of own electric power by consumers who install solar photovoltaic (PV) panels (known as solar distributed generation, or DG), attracts rapidly growing attention of both policy-makers, regulators and the members of the general public. Distributed generation (DG) comes with a lot of benefits: being the most sustainable, cleanest source of energy, solar products facilitates local priorities, such as economic growth, internal security, mitigation against climate change, and employment opportunities. However, there is another side of the coin: despite the rapid success of solar DG, it is still faced with a plethora of issues and challenges.
An increase in the rooftop solar PV in might results in a transfer of wealth and costs between customer groups. There are elderly, disabled and chronically sick citizens who cannot benefit from generating their own electric power using solar PV panels, but who might still face higher electricity bills due to the higher policy support charges (levies) and taxes aimed at supporting decarbonisation through distributed generation. Overall, it appears that current network charging regime is likely to be unfit in the presence of solar PV households who do not contribute to the grid as they should be.

Keywords: entrepreneurship, sustainability, electricity pricing, solar panels, entrepreneurship, distributed generation

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JEL Classifications: M20, Q21, Q41

1. Introduction

There has been a rising need for affordable, green energy in the world that stepped on the path of sustainable growth, decarburization, and climate protection. Unlike the previous years, today's policy makers and regulators require a different context of the market and the economy with the inclusion of planning for the growth of renewable energy (Vosylius et al. 2013; Raudeliūnienė et al. 2014; Baublys et al. 2014; Balitskiy et al. 2014; Leonavičius et al. 2015; Mostenska, Bilan 2015; Šimelytė et al. 2016).

One of the most effective ways how to deal with these problems might be so-called distributed generation (DG), a trend when consumers generate their own electric power by installing solar photovoltaic (PV) panels.

Given that national policies and targets as well as declines in the prices of photovoltaic panels has led to an increase in people's interests in tapping into the solar power industry. However, policy makers and regulators have experienced problems in the analysis of solar energy contribution as compared to others sources in terms of capacity planning, portfolio evaluation and resource procurement decisions (Sterling et al, 2013). Given the global attempt to reduce carbon emissions and increase renewable energy supply, many governments around the world have ventured into launching various policies such as peak pricing for residential customers and net metering. Peak pricing is intended to smoothen the electricity demand all day long by offering higher costs to customers operating at peak-usage times with the effect of increasing the efficiency of electricity supply. Net metering on the other hand enables distributed generators, such as customers with solar panels installed on their rooftops, to feed their excess power back to the grid at retail prices (Kok et al, 2015).

Many US citizens have turned to this type of renewable energy generation technology and installed the panels at their homes and business premises. The increasing trend of PV devices is basically due to the fact that their cost has reduced dramatically and most the citizens can currently afford them. Also, due to climate change, the country is opting for green energy and with this; the government is subsidizing solar products to make them more affordable to its citizens. However, installation of PV panels by customers has resulted in various issues countrywide. Some of these issues regard consumer protection and also the price of electricity.

Compensation for the solar PV customers may be in the form of paying the consumer from the utility where more electricity is generated than what is consumed (the practice widely referred to as "net metering"). Many net metering policies require utilities to purchase a DG consumer's extra power at a total retail price even though the cost of producing the electricity by the utilities is much lower. Because it is the responsibility of the utilities to maintain these electric grids, they shift the cost to the consumers and as a result, the cost of electricity increases. Moreover, these chargers are further shifted to non-solar consumers, which in turn increase their electricity bill. Determination of the right rate for net metering is a complicated issue. The subject regarding electricity prices is on the appropriate retail rate at which to compensate consumers for DG. There is a debate on whether the price to be used to compensate the distributed energy consumers should be below or at the retail rate. This paper discusses the sustainability of distributed generation and electricity pricing which have aroused by the installation of rooftop solar PV panels by consumers who either want to save on their electricity bills or are driven by the entrepreneurial concept.

2. Distributed generation pricing and charges

Generally, all across the USA utility companies have developed various formulae for compensating distributed generators for power flowing into their grids. Two methods have been popularly employed: net metering and feed-in tariffs. Under the net-metering technique, customers with on-site generation are normally credited for the amount of kilowatt-hour (kWh) sales sold back to the grid and are charged for periods in which their consumption is greater than their generation. Utilities usually charge their differences in consumption and generation. There are usually different policies on net metering depending on the state. Some states may limit the fuel types and technology that is eligible for net metering while other states put a limit on the total capacity that the generator is eligible for net metering thus placing limits on both individual generators and the aggregate load that is eligible for net metering (APPA, 2013).

Feed-in tariff (FIT) programs that usually exist in some states refer to a long term contract under which the utility agrees to purchase the excess generation from a distributed generation (DG). The utility company usually comes up with a per-kWh purchase price with the rates varying from utility to utility thus resulting in a lot of contention. In the long run, the utility company pays the DG in a similar manner as they would pay a non-utility wholesale power producer. Under a FIT program, the DG is compensated at the predetermined rate for their surplus power supplied to the grid while the DG's purchases from the grid are charged at the retail rate. The FIT rate can either be higher or lower than the retail rate (APPA, 2013).

Given the growing impact of DG, several utilities have begun trying to implement reforms to existing programs in a bid to raise some of the financial concerns associated with DG. In Arizona, the Arizona Public Service (APS) filed with the Arizona Corporation Commission (ACC) making two policy proposals. They suggested that under the first policy option, existing net metering customers would be charged higher on the basis of their electricity usage with the demand charge ranging from $45 to $80 per month. Another option would involve the establishment of a credit system for new DG customers in which the distributed generators would acquire compensation for electricity sold to the grid at a rate set by the ACC with the amount appearing as a credit on the customer's monthly bill. The first proposal reduced the residential solar customers' monthly savings from 14-16 cents per KWh to 6-10 cents per kWh while the second proposal reduced savings to nearly 4 cents per kWh per month. The APS tried to justify this by stating that the total subsidization of rooftop solar customers' amounts to nearly $18 million per year for their customers and that solar rooftop generation hardly saves utility money. They argued that had these sources not been available, the utility would have purchased that electricity on the wholesale market at a cheaper price as compared to the current system, in which rooftop generators are compensated at the full retail rate (APPA, 2013).

3. Entrepreneurship and rooftop solar panels

Rooftop solar PV panels directly transfer property from ordinary electric consumers. This is because most individuals purchase rooftop solar panels since they believe it will save them cash or make them green, or both (Pool, 2012). But the certainty is that rooftop solar should not be saving them money although it frequently does, and it virtually unquestionably is not green. In particular, the rooftop-solar fashion is consuming billions of dollars annually that could be used on greener drives. It also is checking the progress of much more cost-efficient renewable reservoirs of energy

According to a current Energy Department-supported research at North Carolina State University, establishing a fully funded, average-size rooftop solar scheme will decrease energy prices for 93% of the single-family homes in the fifty greatest American capitals today (Potts, 2015). That is why individuals have been hurrying out to purchase rooftop solar panels, especially in sunny states like California, Arizona, and New Mexico. The principal cause is that these modest solar systems are cost-efficient. Nonetheless, they are profoundly supported. Monopolies are required by law to buy solar energy produced from the rooftops of homeowners and companies at two to three times higher than it would require buying solar power from great, individually controlled solar plants. Without governmental subsidies, rooftop solar far from cost-efficient.

Nevertheless, current investigations by Lazard and other firms discovered that comprehensive, utility-scale solar energy factories require as little as five pence or sixpence without a premium per kilowatt-hour to make and run in the sunny Southwest ("Net Metering: Growing, Worrisome Trend", 2012). These factories are rival with correspondingly sized fossil-fueled energy factories. However, this performance is likely only if solar factories are broad and found in sunny sections of the nation. On average, advantage-scale solar factories countrywide still necessitate about 13 cents per kilowatt-hour, versus approximately six cents per kilowatt-hour for natural gas and coal.

Large-scale solar power rates are dropping since the expense to build solar panels has been declining and since big solar installations authorize economies of scale. On the other hand, rooftop solar usually requires micro installations in unproductive areas, which makes the overall value as much as three and a half times higher. There are lots of reasons as to why we are paying more for the same sun. Well-intended but ill-thought national, state and regional tax considerations for rooftop solar in the United States yield back between 30% and 40% of the establishment charges to the owner as a contribution credit ("Net Metering: Growing, Worrisome Trend", 2012).

But more questionable are unknown rate payments, the most notable of which is termed net metering, which is accessible in 44 US states. Net metering enables solar system buyers to compensate on a one-for-one principle the power they draw from the electrical grid with the solar energy they produce on their home.

Although this might seem reasonable, it is not. An ordinary California citizen with rooftop solar PV, for instance, frequently pays approximately 17 cents per kilowatt-hour for electrical assistance if the home's solar panels are not functioning. When they are working, nonetheless, net metering expects the business to give that solar consumer the same 17 cents per kilowatt-hour ("Net Metering: Guilty as Charged", 2013). But the solar customer still requires the framework to back up his occasional solar panels, and the service could have acquired that very solar energy from a utility-scale solar electrical factory for approximately five cents per kilowatt-hour.

This 12-cents-per-kwh charge variation results in a wealth transfer from ordinary electric consumers to consumers with rooftop solar systems who also usually have soaring wages. This is because businesses receive much of their adjusted payments—the inevitable charges of power manufactories, delivery lines, from private consumers through variable-use prices, in other terms, prices based on how much energy they apply. When a consumer with rooftop solar buys insufficient power from the business, he gives fewer variable-use costs and bypasses giving tax to meet the utility's established charges. The effect is that all of the other consumers have to pick up the variation. The California Public Services Commission predicts that net metering will cost the nation $1.1 billion annually by 2020. Arizona Public Service Company estimates that if the prevailing speed of rooftop-solar establishment proceeds through mid-2017, its non-solar consumers will give roughly $800 million in raised charges to support rooftop solar customers over the next 20 years (Pool, 2012). The entire expenses nationwide are unknown. Nonetheless, an interdisciplinary association of professors and researchers at MIT published research about the prospect of solar energy and presumed that net metering is ineffective and should be redesigned (MIT, 2015).

Thus, passing on additional costs or delta revenue losses attributed to DG onto the balance of other utility customers is likely to be a wealth transfer from the less affluent to the more affluent. This generally means that utility companies will set high fixed charges which will be shared by all the customers. Low income customers consuming less electricity than others will therefore be subject to higher electric bills. Payment of DG at full retail price or compensation for excess generation at full retail price will force the inclusion of distribution costs even though DG customers do not aid the utility companies in saving on distribution costs. This will result in higher fixed charges which slow down the long run energy efficiency efforts (APPA, 2013).

Currently, DG has partly grown due to the fact that firms have entered the market to provide customers different financing, leasing or agreements for power purchases which do not need high capital as buying the panels downright. A marketplace which is functioning well necessitates that consumers be able to access the necessary information in weighing the financial costs as well as benefits of different options for solar PV panels' installation. Even though distributed energy is progressively more important in meeting the energy and environmental objectives of the United States, installations of rooftop solar panels is still faced with problems concerning consumer protection. Evidently, consumers lack the vital information regarding the distributed generation, and as a result, many companies have resulted into exploiting these uninformed consumers in various ways (Deline et al., 2011).

Various firms which are leasing solar products are engaging themselves in sales malpractices. The companies take advantage of consumers with no knowledge of what they should pay for electricity and the solar PV panels. Moreover, some customers do not understand under which circumstances their payments shall rise as per the agreements. For instance, cost savings of energy which some PV corporations claim in their transactions fields are frequently higher compared to the real savings as they used cost predictions assumptions which were highly inflated. In several cases, because of automatic increase terms set in solar leases, buyers end up compensating more for the solar energy compared to that they would have compensated traditional energy firms at the meter rate. Further, consumers are unaware that these payments might double in the course of the lease contract. Also, they do not know the amount of interest rate charged, though these types of requirements are clearly stated in cases of short-term car leases.

A place like Arizona the sun is a nearly ever-present resource, but most of bad actor PV firms have charged in court many consumers for failing to connect solar systems after making a deposit and also have been illegally soliciting the customers through phone calls on the numbers listed on the National Do Not Call Registry to exaggerating the solar savings. In March 2016, a federal court action was filed by the FTC, which alleged that 1.3 million individuals on the Do Not Call Registry list were victims of unlawful telemarketing entities who acted for various solar companies. The phone calls are just a case amongst much deceptive advertising, wrong information, irritating sales campaigns, faulty installations and undisclosed charges and other complaints from consumers. Vividly, an example of overstated savings techniques is from a local media station in Georgia that made a video record of a salesman for PVs making blown up promises to consumers and highly overstated the yearly savings from solar system installation. In Louisiana, a company misled customers through exaggerating energy cost savings, failure to fix the solar equipment timely, and violation of national license prerequisites for PV installers (Li and Yi, 2014).

4. Implications for network pricing

Let us consider a case study of how current and existing network charging and pricing regimes can rapidly become unfit for purpose in the presence of a big uptake of solar energy. In many cases, it happens that promotion of distributed generation may lead to an opposite effect becoming an opportunity for shifting the wealth from poorer to richer households and businesses. First of all, let us take a look at the cost recovery by distribution system operators (DSO) in EU countries. Table 1 shows the structure of the cost recovery for households and small industries for different groups of countries and grouping the countries by the volumetric component and fixed and capacity component.

Table 1. Cost recovery by distribution system operators (DSO) in the EU countries

Households	Volumetric Component	NL	ES, SE	NO	IE, IT, PL, PT, SK, SI	AT, CY, CZ, FR, DE, GB, GR, HU, LU, RO	BG
	Fixed + Capacity Component	BG	AT, CY, CZ, FR, DE, GB, GR, HU, LU, RO	IE, IT, PL, PT, SK, SI	NO	ES, SE	NL
Small industrials	Volumetric Component	NL	IT, LU, ES,	AT, PL, SI,	CZ, FI, FR, HU, SE	BG, CY, DE, GB, GR, SK	RO
	Fixed + Capacity Component	RO	BG, CY, DE, GB, GR, SK	CZ, FI, FR, HU, SE	AT, PL, SI	IT, LU, ES	NL

Source: European Commission (2015) and Eurelectric (2014)

It becomes obvious that there is a difference between the variability and fixed charges with most of consumer probably preferring to pay higher fixed fees that are not always profitable for them. Furthermore, Table 2 employs the methodology described in Simshauser (2014) to show the differences in network charges for solar and non-solar residential consumers in Northern England. The last two rows of the table depict the savings the solar PV and non-solar PV households have from using either two-part tariff scheme of the demand tariff scheme.

Table 2. Differences for Residential solar PV and non-PV households in Northern England

	Household A	*Household B*
	No Solar PV	*Solar PV*
Maximum Demand (kW)	1.05	1.69
Metered import (kWh)	1589.184	1799.939
Solar Export (kWh)	0	740.349
Gross Demand (kWh)	1589.184	2540.088
Number of customers	3100000	59751
% of customers (referred to the main group)	16 %	12 %
Two-part tariff	£141.97	£132.86
Demand Tariff	£37.55	£33.23

Note: Two-part tariff and demand tariff are expressed in annual charges per household (£)
Source: Own results

Looking at the results presented in Table 2, one can see that UK's solar PV household clearly benefit more from a two-part tariff scheme. The difference between the two-part tariff and the demand tariff is almost sevenfold. Even though the magnitude is several times less than in the case of Australia reported in Simshauser (2016), the core of the problem remains the same: the solar PV households are subsidized by the non-solar PV households due to the current UK tariff charges.

Conclusions and policy implications

Overall, it seems that large-scale solar energy does not get these same hidden-rate subsidies. When businesses produce or buy production from massive solar plants, they spread the charges out smoothly to consumers. Each dollar consumed on rooftop solar is a dollar not spent on additional, more prolific renewable sources. Frequently, businesses across the nation have been asking questions to the predicaments with rooftop solar. They have been advancing the study of large-scale solar and other renewables, the balance of rooftop solar payments and a restructuring of charged prices to promote new technologies. However, for example in the United States the federal payments for solar electricity cost up to about $5 billion annually, with more than half of that measure going to the rooftop and other, more valuable, non-utility solar factories. If the national government allocated the $5 billion rather than subsidizing solely utility-scale solar companies, one can assume that it could double the quantity of solar power established in this nation every year by about 65%. Furthermore, without country and local subsidies for rooftop solar, the US economy could be spared billions of dollars annually. It becomes quite obvious that rooftop PV solar owners do not contribute to the grid as they should.

Moreover, it appears that most customers do not have the relevant information on DG policies. The problem of increasing electricity prices for non-consumers and also the users is also adversely affecting the development of solar DG. Therefore, the government and other stakeholders must intervene and enlighten people on the policies, the concept of net metering and the pricing of solar products so as to protect them. Given many countries in the world are dangerously being affected by climate change, the use of solar renewable energy would be of great benefit in controlling the environmental hazards caused by the use of non-renewable energy on the environment.

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